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ACCURATE TRANSLATION OF PRIORITY DOCUMENT

The undersigned, of the below address, hereby states that he/she well knows both the English and Japanese languages, and that the attached is an accurate translation into the English language of the Certified Copy, filed for this application under 35 U.S.C. Section 119 and/or 365, of:

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SPECIFICATION

TITLE OF THE INVENTION

HOLOGRAM TRANSFER FOIL

5 SCOPE OF WHAT IS CLAIMED

1. A hologram transfer foil comprising a substrate and a transfer layer laminated thereon, said transfer layer comprising a surface protective layer, a barrier layer, a hologram layer and a heat seal layer in this order, wherein  
10 when said hologram transfer foil is applied on said heat seal layer side to an application member, the peel force between said substrate and said surface protective layer is smaller than that between adjacent layers in other layers.

2. The hologram transfer foil of claim 1,  
15 characterized in that the hologram layer is a volume hologram layer.

3. The hologram transfer foil of claim 1, characterized in that the hologram layer is a surface relief hologram layer.

20 4. The hologram transfer foil of any one of claims 1 to 3, characterized in that the barrier layer is a heat-sealable, aqueous adhesive layer.

DETAILED EXPLANATION OF THE INVENTION

[0001]

25 ART FIELD TO WHICH THE INVENTION PERTAINS

The present invention relates to a hologram transfer foil which enables a hologram to be applied to any desired application member.

[0002]

30 PRIOR ART

A hologram provides a means capable of recording information in its thickness direction, and recording and reconstructing three-dimensional images. Holograms are now fabricated by known fabrication processes. Typically, the  
35 holograms are used for prevention of illegal copying of ID cards, bank cards, etc., because they are fabricated by precise operations using optical equipment and so are very difficult to fake. In addition, the holograms are expressed

in interference colors of light and so have an outside appearance hardly achievable by other imaging means.

[0003]

5 In a typical application taking full advantage of the aforesaid features of holograms, a hologram adhesive label, obtained in a film form with an adhesive attached thereto, is applied to a variety of associated members. Such a hologram adhesive label has a multilayer structure generally comprising a release sheet/adhesive layer/hologram  
10 layer/surface protective layer/substrate. The surface protective layer is provided for the purpose of protecting the hologram recorded in the hologram layer. Usually, such a surface protective layer contains various additives with a view to imparting thereto hard coatability, printability,  
15 slip capability, etc. However, the direct provision of such a surface protective layer onto the hologram layer is not preferable for both a transfer foil and an application member with a hologram transferred thereto by the transfer foil, because the migration of low-molecular-weight components such  
20 as solvents and surfactants from the surface protective layer into the hologram layer or the migration of low-molecular-weight components such as monomers and solvents in the hologram layer causes disorder in the reconstructed hologram image, etc.

25 [0004]

#### PROBLEM TO BE SOLVED BY THE INVENTION

A primary object of the present invention is to provide a hologram transfer foil which enables a hologram image, etc. to be reconstructed in an uninterrupted manner, and is  
30 improved in terms of releasability with respect to a substrate, especially when the hologram is of the surface relief type.

[0005]

#### MEANS FOR SOLVING THE PROBLEM

35 The present invention provides a hologram transfer foil comprising a substrate and a transfer layer laminated thereon, said transfer layer comprising a surface protective layer, a barrier layer, a hologram layer and a heat seal

layer in this order, wherein when said hologram transfer foil is applied on said heat seal layer side to an application member, the peel force between said substrate and said surface protective layer is smaller than that between adjacent layers in other layers.

[0006]

The hologram transfer foil is characterized in that the hologram layer is a volume hologram layer.

[0007]

10 The hologram transfer foil is characterized in that the hologram layer is a surface relief hologram layer.

[0008]

The hologram transfer foil is characterized in that the barrier layer is a heat-sealable, aqueous adhesive layer.

15 [0009]

#### EMBODIMENTS OF THE INVENTION

A section of one embodiment of the hologram transfer foil of the present invention is shown in Fig. 1 wherein reference numeral 1 represents a hologram transfer foil, 2 a hologram layer, 3 a heat seal layer, 4 a barrier layer, 5 a surface protective layer, 6 a substrate, and 7 a releasable sheet. When the hologram layer 2 is a surface relief type hologram layer, a reflective layer may be interposed between the hologram layer 2 and the heat seal layer 3.

25 [0010]

Reference is now made to the substrate forming part of the hologram transfer foil according to the present invention and the material forming each layer. For the substrate 6, for instance, use may be made of polyethylene terephthalate (PET) films, polyvinyl chloride (PVC) films, polyvinylidene chloride films, polyethylene films, polypropylene films, polycarbonate films, cellophane films, acetate films, nylon films, polyvinyl alcohol films, polyamide films, polyamide-imide films, ethylene-vinyl alcohol copolymer films, polymethyl methacrylate (PMMA) films, polyether sulfone films, and polyether ether ketone (PEEK) films. The substrate 6 has a thickness of usually about 5 to 200  $\mu\text{m}$ , and preferably 10 to 50  $\mu\text{m}$ , and may be either transparent or opaque. It is

here noted that the substrate is released off after the transfer layer is transferred from the hologram transfer foil onto the application member. The substrate may be transparent or opaque, and be used in a sheet or carrier tape form.

[0011]

The hologram layer 2 may be made up of either a volume hologram or a surface relief hologram. An account is given of the case where the hologram layer 2 is made up of a volume hologram layer. To fabricate a volume hologram, a volume hologram-forming material is coated on a temporary substrate such as one represented by substrate 6 to form a hologram-forming layer. Then, interference fringes equivalent to the wavefronts of light from an object are recorded in the hologram-recording layer in the form of transmittance modulation or refractive index modulation. For replication, the hologram-recording layer should be in close contact with a master volume hologram, followed by exposure and development.

[0012]

For the volume hologram layer-forming material, all known volume hologram-recording materials inclusive of silver salts materials, dichromated gelatin emulsions, photo-polymerizable resins and photo-crosslinkable resins may be used. In particular, preference is given to photosensitive materials designed for recording of dry volume holograms, comprising a matrix polymer, a photo-polymerizable compound, a photo-polymerization initiator and a sensitizing dye.

[0013]

The photo-polymerizable compounds used herein, for instance, include photo-polymerizable, photo-linkable monomers, oligomers and prepolymers, each containing at least one ethylenical unsaturated bond per molecule as will be explained later, which may be used alone or in admixture. Exemplary compounds are unsaturated carboxylic acids or their salts, esters of unsaturated carboxylic acids and aliphatic polyvalent alcohol compounds, and amide combined products of

unsaturated carboxylic acids and aliphatic polyvalent amine compounds.

[0014]

Exemplary unsaturated carboxylic acid monomers are  
5 acrylic acid, methacrylic acid, itaconic acid, crotonic acid, isocrotonic acid and maleic acid as well as their halogen-substituted unsaturated carboxylic acids such as chlorinated unsaturated carboxylic acids, brominated unsaturated carboxylic acids and fluorinated unsaturated carboxylic  
10 acids. Examples of the salts of unsaturated carboxylic acids are sodium, potassium or like salts of the aforesaid acids.

[0015]

The ester monomers of aliphatic polyvalent alcohol compounds and unsaturated carboxylic acids may include those  
15 classified as acrylic acid esters, for instance, ethylene glycol diacrylate, triethylene glycol diacrylate, 1,3-butanediol diacrylate, tetramethylene glycol diacrylate, propylene glycol diacrylate, neopentyl glycol diacrylate, trimethylolprpane triacrylate, trimethylolpropane tri  
20 (acryloyloxypropyl) ether, trimethylolethane triacrylate, hexanediol diacrylate, 1,4-cyclohexanediol diacrylate, tetraethylene glycol diacrylate, pentaerythritol diacrylate, pentaerythritol triacrylate, pentaerythritol tetraacrylate, dipentaerythritol diacrylate, dipentaerythritol triacrylate,  
25 dipentaerythritol tetraacrylate, dipentaerythritol hexaacrylate, sorbitol triacrylate, sorbitol tetraacrylate, sorbitol pentaacrylate, sorbitol hexaacrylate, tri (acryloyloxyethyl) isocyanurate, polyester acrylate oligomer, 2-phenoxyethyl acrylate, 2-phenoxyethyl methacrylate, phenol  
30 ethoxylate monoacrylate, 2-(p-chlorophenoxy)ethyl acrylate, p-chlorophenyl acrylate, phenyl acrylate, 2-phenylethyl acrylate, (2-acryloxyethyl) ether of bisphenol A, ethoxylated bisphenol A diacrylate, 2-(1-naphthyloxy)ethyl acrylate, o-biphenyl methacrylate and o-biphenyl acrylate.

35 [0016]

Methacrylic acid esters, for instance, include tetramethylene glycol dimethacrylate, triethylene glycol dimethacrylate, neopentyl glycol dimethacrylate,

trimethylolpropane trimethacrylate, trimethylolethane  
trimethacrylate, ethylene glycol dimethacrylate, 1,3-  
butanediol dimethacrylate, hexanediol dimethacrylate,  
pentaerythritol dimethacrylate, pentaerythritol  
5 trimethacrylate, pentaerythritol tetramethacrylate,  
dipentaerythritol dimethacrylate, dipentaerythritol  
hexamethacrylate, sorbitol trimethacrylate, sorbitol  
tetramethacrylate, bis-[p-3-methacryloxy-2-hydroxypropoxy)  
phenyl]dimethylmethane, bis-[p-(acryloxyethoxyphenyl)  
10 dimethylmethane, 2,2-bis(4-methacryloyloxyphenyl)propane, and  
methacrylic acid-2-naphthyl.  
[0017]

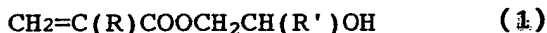
Itaconic acid esters, for instance, include ethylene  
glycol diitaconate, propylene glycol diitaconate, 1,3-  
15 butanediol diitaconate, 1,4-butanediol diitaconate,  
pentaerythritol diitaconate and sorbitol tetraitaconate.  
Cotonic acid esters, for instance, include ethylene glycol  
isocrotonate, tetramethylene glycol dicrotonate,  
pentaerythritol dicrotonate, and sorbitol tetraacrotonate.  
20 The ester monomers of aliphatic polyvalent alcohol compounds  
and unsaturated carboxylic acids may include those classified  
as isocrotonic acid esters, for instance, ethylene glycol  
diisocrotonate, pentaerythritol diisocrotonate, and sorbitol  
tetraisocrotonate.  
25 [0018]

Maleic acid esters, for instance, include ethylene  
glycol dimaleate, triethylene glycol dimaleate,  
pentaerythritol dimaleate, and sorbitol tetramaleate.  
Halogenated unsaturated carboxylic acids, for instance,  
30 include 2,2,3,3-tetrafluoropropyl acrylate, 1H,1H,2H,2H-  
heptadecafluorodecyl acrylate, 2,2,3,3-tetrafluoropropyl  
methacrylate, 1H,1H,2H,2H-heptadecafluorodecyl methacrylate,  
methacrylic acid-2,4,6-tribromophenyl, dibromoneopentyl  
dimethacrylate (available under the trade name of NK Ester  
35 DBN, Shi-Nakamura Chemical Industries, Ltd.), dibromopropyl  
acrylate (available under the trade name of NK Ester A-DBP,  
Shin-Nakamura Chemical Industries, Ltd.), dibromopropyl  
methacrylate (available under the trade name of NK Ester DBP,

Shin-Nakamura Chemical Industries, Ltd.), methacrylic acid chloride, methacrylic acid-2,4,6-trichlorophenyl, p-chlorostyrene, methyl-2-chloroacrylate, ethyl-2-chloroacrylate, n-butyl-2-chloroacrylate, tribromophenol  
5 acrylate, and tetrabromophenol acrylate.  
[0019]

The amide monomers of unsaturated carboxylic acids and aliphatic polyvalent amine compounds, for instance, may include methylenebisacrylamide, methylenebismethacrylamide,  
10 1,6-hexamethylenebisacrylamide, 1,6-hexamethylenebismethacrylamide, diethylenetriaminetrisacrylamide, xylylenebisacrylamide, xylylenebismethacrylamide, N-phenylmethacrylamide, and diacetone acrylamide.  
[0020]

15 Besides, the photo-polymerizable compounds may include polyisocyanate compounds having two or more isocyanate groups per molecule, as described in JP-B 48-41708, vinylurethane compounds having two or more polymerizable vinyl groups per molecule, with the addition thereto of a hydroxyl group-  
20 containing vinyl monomer represented by  
[0021]



where R and R' each stand for a hydrogen atom or a methyl group), etc.

25 Urethane acrylates as set forth in JP-A 51-37193, and polyester acrylates, epoxy resins and polyfunctional acrylates or methacrylates such as (meth)acrylic acids as shown in JP-A 48-64183 and JP-B's 49-43191 and 52-30490, respectively, may also be used in the present invention. In  
30 addition, compounds referred to as photo-curable monomers and oligomers in The Journal of Adhesion Society of Japan, Vol. 20, No. 7, pp. 300-308 (1984) may be used. For the photo-polymerizable compounds used herein, use may further be made of phosphorus-containing compounds such as mono(2-  
35 acryloyloxyethyl) acid phosphate (available under the trade name of Light Ester PA, Kyoeisha Oil & Fat Chemical Industries, Ltd.), mono(2-methacryloyloxyethyl) acid phosphate (available under the trade name of Light Ester PM,

Kyoeisha Oil & Fat Chemical Industries, Ltd.), epoxy acrylate compounds (available under the trade names of Ripoxy VR-60 and Ripoxy VR-90, Showa Polymer Co., Ltd.), and NK Ester M-230G and NK Ester 23G, both made by Shin-Nakamura Chemical

5 Industries, Ltd.

[0022]

Use may further be made of triacrylates having the following structural formulae (2) and (3) and available under the trade names of Alonix M-315 and Alonix M-325, Toa

10 Synthesis Chemical Industries, Ltd.):

[0023]

Alonix M-315



[ 0024 ]

Alonix M-325



15

20

[ 0025 ]

25

30

glycolate (BPBG); aliphatic dibasic acid ester plasticizers such as (di-2-ethylhexyl)adipate (DIDA), (di-n-hexyl)azelate (DNHZ), (di-2-ethylhexyl)azelate (DOZ), dibutyl sebacate (DBS) and (d-2-ethylhexyl)sebacate (DOS); citrate  
5 plasticizers such as triethyl citrate (TEC), tributyl citrate (TBC), acetyl triethyl citrate (ATEC) and acetyl tributyl citrate (ATBC); epoxy plasticizers such as epoxylated soybean oil; and phosphate plasticizers such as tributyl phosphate (TBP), triphenyl phosphate (TPP), tricresyl phosphate (YCP)  
10 and tripropylene glycol phosphate.

[0026]

For the photo-polymerization initiator in the initiator system, for instance, 1,3-di(t-butylldioxycarbonyl) benzophenone, 3,3',4,4'-tetrakis(t-butylldioxycarbonyl)  
15 benzophenone, N-phenylglycine, 2,4,6-tris(trichloromethyl)-s-triazine, 3-phenyl-5-isooxazolone, 2-mercaptobenzimidazole, and imidazole dimers may be used. In view of the stabilization of the recorded hologram, the photo-polymerization initiator should preferably be removed by  
20 decomposition after hologram recording. For instance, organic peroxide initiators are preferred because of being easily decomposed by ultraviolet irradiation.

[0027]

Exemplary sensstizing dyes are those having absorption  
25 light at 350 to 600 nm such as thiopyrylium salt dyes, merocyanine dyes, quinoline dyes, styrylquinoline dyes, ketocoumarin dyes, thioxanthene dyes, xanthene dyes, oxonol dyes, cyanine dyes, rhodamine dyes, pyrylium ion dyes, and diphenylidonium ion dyes. It is here noted that it is  
30 acceptable to use sensitizing dyes having absorption light at a wavelength less than 350 nm or greater than 600 nm.

[0028]

The matrix polymer used herein, for instance, includes copolymers (or a mixture thereof) comprising as a  
35 polymerization component or components at least one copolymerizable component selected from the group consisting of polymethacrylic acid ester or its partial hydrolysate, polyvinyl acetate or its hydrolysate, polyvinyl alcohol or

its partially acetallized product, triacetyl cellulose, polyisoprene, polybutadiene, polychloroprene, silicone rubber, polystyrene, polyvinyl butyral, polyvinyl chloride, chlorinated polyethylene, chlorinated polypropylene, poly-N-  
5 vinylcarbazole or its derivative, poly-N-vinylpyrrolidone or its derivative, copolymer of styrene and maleic anhydride or its half ester, acrylic acid, acrylic acid ester, methacrylic acid, methacrylic acid ester, acrylamide, acrylnitrile, ethylene, propylene, vinyl chloride and vinyl acetate. For  
10 the matrix polymer, it is more preferable to use polyisoprene, polybutadiene, polychloroprene, polyvinyl alcohol, polyvinyl acetal that is a partially acetallized product of polyvinyl alcohol, polyvinyl butyral, polyvinyl acetate, ethylene-vinyl acetate copolymer and vinyl chloride-  
15 vinyl acetate copolymer which may be used alone or in admixture. The recorded hologram is stabilized by the step of migrating the monomers by heating. To this end, these matrix polymers have to have a relatively low glass transition temperature and so make the migration of monomers  
20 easy.

[0029]

The photo-polymerizable compound should be used in an amount of usually 10 part by weight to 1,000 parts by weight, and preferably 10 parts by weight to 100 parts by weight, per  
25 100 parts by weight of polymer matrix. The photo-polymerization initiator should be used in an amount of usually 1 part by weight to 10 parts by weight, and preferably 5 parts by weight to 10 parts by weight, per 100 parts by weight of polymer matrix. The sensitizing dye  
30 should be used in an amount of usually 0.01 part by weight to 1 part by weight, and preferably 0.01 part by weight to 0.5 parts by weight, per 100 parts by weight of polymer matrix. Other volume hologram-forming materials, for instance, are a variety of nonionic, anionic and cationic surface active  
35 agents.

[0030]

These hologram-recording materials are dissolved in a suitable solvent such as acetone, methyl ethyl ketone, methyl

isobutyl ketone, cyclohexanone, benzene, toluene, xylene, chlorobenzene, tetrahydrofran, methyl cellosolve, ethyl cellosolve, methyl cellosolve acetate, ethyl cellosolve acetate, ethyl acetate, 1,4-dioxane, 1,2-dichloroethane, 5 dichloromethane, chloroform, methanol, ethanol and isopropanol or a mixture thereof to form a coating solution having a solid content of 15% to 25%. The hologram-recording layer should have a thickness of usually 0.1 to 50  $\mu\text{m}$ , and preferably 1 to 20  $\mu\text{m}$  as measured after drying.

10 [0031]

Next, reference is made to another embodiment of the present invention, wherein the hologram layer 2 is made up of a surface relief hologram layer. For the fabrication of the surface relief hologram, for instance, a hologram-forming 15 layer is first formed by coating a surface relief hologram-forming material on a temporary substrate such as one represented by the aforesaid substrate 6. Then, a press stamper prepared from a master hologram using laser light is thermally pressed on the surface of the hologram-forming 20 layer to form a fine relief pattern thereon. This hologram layer may be formed of every material used for conventional relief hologram-forming layers. By way of example but not by way of limitation, various resin materials such as thermosetting resins, barriers and ionizing radiation-curing 25 resins may be used. The thermosetting resins used herein, for instance, include unsaturated polyester resin, acrylic-modified urethane resin, epoxy-modified acrylic resin, epoxy-modified unsaturated polyester resin, alkyd resin and phenol resin, and the barriers, for instance, include acrylate 30 resin, acrylamide resin, nitrocellulose resin and polystyrene resin. These resins may be made up of homopolymers or copolymers comprising at least two components, and may be used alone or in combination of two or more. These resins may additionally contain various isocyanate compounds, 35 metallic soaps such as cobalt naphthenate and zinc naphthenate, organic peroxides such as benzoyl peroxide and methyl ethyl ketone peroxide, thermal or ultraviolet curing agents such as benzophenone, acetophenone, anthraquinone,

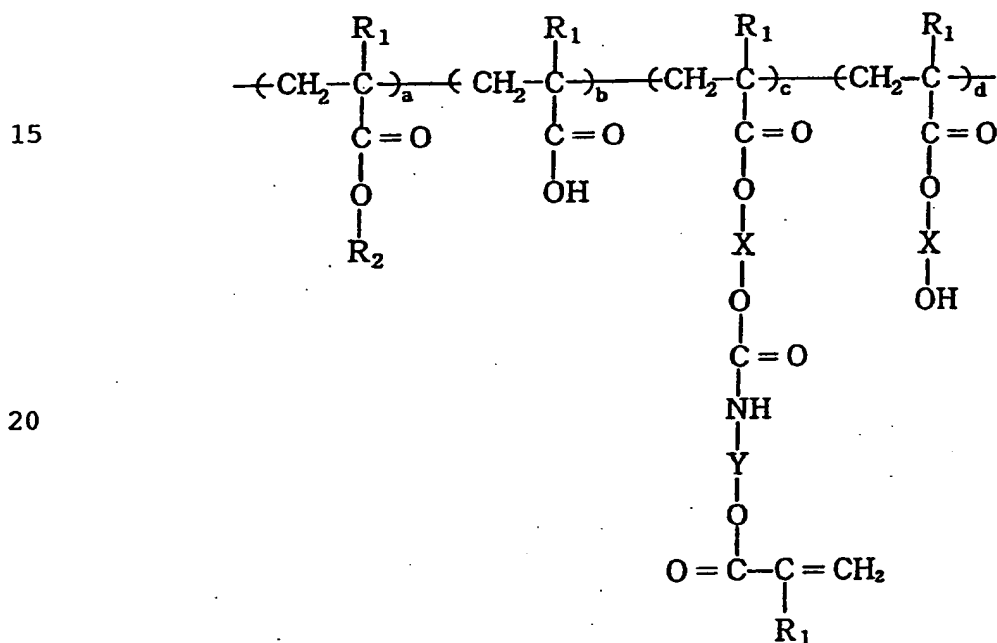
naphthoquinone, azobisisobutyronitrile and diphenyl sulfide, and so on.

[0032]

The ionizing radiation-curable resins used herein, for instance, include epoxy-modified acrylate resins, urethane-modified acrylate resins and acrylic-modified polyesters. Of these, the urethane-modified acrylate resins are preferable, although the urethane-modified acrylic resin represented by the following general formula is most preferred.

10 [0033]

# General Formula



25

Here five  $R_1$ 's are each independently a hydrogen atom or a methyl group,  $R_2$  is a  $C_{1-16}$  hydrocarbon group, and X and Y are each a straight- or branched-chain alkylene group. On the premise that  $(a+b+c+d) = 100$ ,  $a$  is an integer of 20 to 90,  $b$  is an integer of 0 to 50,  $c$  is an integer of 10 to 80, and  $d$  is an integer of 0 to 20.

30

One preferable example of the aforesaid urethane-modified acrylic resin is obtained by the reaction of

methacryloyloxyethyl isocyanate(2-isocyanate ethyl methacrylate) with hydroxyl groups present in an acrylic copolymer obtained by the copolymerization of 20 to 90 moles of methyl methacrylate, 0 to 50 moles of methacrylic acid and  
5 10 to 80 moles of 2-hydroxyethyl methacrylate.

[0034]

Thus, it is not required that the aforesaid methacryloyloxyethyl isocyanate react with all the hydroxyl group present in the copolymer; that is, only the reaction of  
10 methacryloyloxyethyl isocyanate with at least 10 mol%, and preferably at least 50 mol% of hydroxyl groups in the 2-hydroxyethyl methacrylate in the copolymer is needed. In place of or in combination with the aforesaid 2-hydroxyethyl methacrylate, hydroxyl-containing monomers may be used, for  
15 instance, N-methylolacrylamide, N-methylolmethacrylamide, 2-hydroxyethyl acrylate, 2-hydroxyethyl methacrylate, 2-hydroxypropyl acrylate, 2-hydroxyethyl methacrylate, 4-hydroxybutyl acrylate and 4-hydroxybutyl methacrylate.

[0035]

20 For instance, when a diffraction grating or the like is formed by a resin composition comprising as its main component the urethane-modified acrylic resin with many methacryloyl groups introduced in its molecule using the hydroxyl groups present in the hydroxyl group-containing  
25 acrylic resin, as mentioned above, it is possible to use ionizing radiation such as ultraviolet rays or electron beams as curing means. In addition, the resultant diffraction grating or the like is much more improved in flexibility, heat resistance, etc., albeit having a high crosslinking  
30 density.

[0036]

The aforesaid urethane-modified acrylic resin may be obtained by dissolving the aforesaid copolymer in a solvent such as toluene, ketone, cellosolve acetate or dimethyl  
35 sulfoxide to prepare a solution. While the solution is stirred, the methacryloyloxyethyl isocyanate is added dropwise thereto for the reaction of the isocyanate group with hydroxyl groups in the acrylic resin, yielding an

urethan bond, through which the methacryloyl group can be introduced in the resin. Referring here to the amount of the methacryloyloxyethyl isocyanate used, the isocyanate group is used in an amount of 0.1 to 5 moles, and preferably 0.5 to 3 moles per hydroxyl group in the acrylic resin. It is then appreciated that when the methacryloyloxyethyl isocyanate is used in excess of the equivalent of the hydroxy groups in the aforesaid resin, there is a possibility that a -CONH-CH<sub>2</sub>CH<sub>2</sub>-bond may occur through the reaction of said methacryloyloxyethyl isocyanate with carboxyl groups in the resin.

[0037]

While the present invention has been described with reference to the cases where all R<sub>1</sub>'s and R<sub>2</sub> are methyl groups and both X and Y are ethylene groups, it is understood that the present invention is not limited thereto. For instance, the present invention also includes the cases where five R<sub>1</sub>'s are each independently a hydrogen atom or a methyl group, R<sub>2</sub> is a methyl group, an ethyl group, an n- or iso-propyl group, an n-, iso- or tert-butyl group, a substituted or unsubstituted phenyl group, and a substituted or unsubstituted benzyl group, and X and Y are each an ethylene group, a propylene group, a diethylene group, and a dipropylene group. The thus obtained urethane-modified acrylic resin should have an overall weight-average molecular weight of 10,000 to 200,000, and preferably 20,000 to 40,000 as measured by GPC on a standard polystyrene weight basis.

[0038]

When such an ionizing radiation-curing resin is cured, the aforesaid monomers may be used in combination with such mono- or poly-functional monomers or oligomers as mentioned below for the purpose of control of crosslinked structure, viscosity, etc.

[0039]

Exemplary monofunctional monomers are mono(meth)acrylates such as tetrahydrofurfuryl (meth)acrylate, hydroxyethyl (meth)acrylate, vinyl pyrrolidone, (meth)acryloyloxyethyl succinate and (meth)acryloyloxyethyl phthalate. As classified in terms of skeleton structure, di-

or poly-functional monomers include polyol (meth)acrylates such as epoxy-modified polyol (meth)acrylate, lactone-modified polyol (meth)acrylate, polyester (meth)acrylate, epoxy (meth)acrylate and urethane (meth)acrylate, and other  
5 poly (meth)acrylates having polybutadiene, isocyanuric acid, hydantoin, melamine, phosphoric acid, imide and phosphazine skeletons. Thus, various monomers, oligomers and polymers capable of being cured by ultraviolet radiation and electron beams may be used.

10 [0040]

To be more specific, exemplary difunctional monomers and oligomers include polyethylene glycol di(meth)acrylate, polypropylene glycol di(meth)acrylate, neopentyl glycol di(meth)acrylate and 1,6-hexanediol di(meth)acrylate, and  
15 exemplary trifunctional monomers, oligomers and polymers are trimethylolpropane tri(meth)acrylate, pentaerythritol tri(meth)acrylate and an aliphatic tri(meth)acrylate. Exemplary tetrafunctional monomers, oligomers and polymers include pentaerythritol tetra(meth)acrylate,  
20 ditrimethylolpropane tetra(meth)acrylate and an aliphatic tetra(meth)acrylate. Exemplary penta- or poly-functional monomers, oligomers and polymers include dipentaerythritol penta(meth)acrylate and dipentaerythritol hexa(meth)acrylate. Besides, (meth)acrylates having polyester, urethane and  
25 skeletons may be used. Although the number of functional groups is not critical, it is appreciated that the number of functional groups of less than 3 makes heat resistance likely to become low, and the number of functional groups exceeding 20 makes flexibility likely to become low. It is thus  
30 preferred that the number of functional groups be in the range of 3 to 20.

[0041]

To form a relief hologram in the hologram-forming layer composed of the aforesaid materials, a press stamper with a  
35 relief pattern formed on its surface is pressed against the surface of the hologram-forming layer to transfer the relief pattern onto the surface of the hologram-forming layer. Preferably in this case, a release agent should be previously

incorporated in the hologram-forming layer so as to provide an easy release of the hologram-forming layer from the press stamper. For this release agent, use may be made of any of release agents known so far in the art, for instance, solid  
5 waxes such as polyethylene wax, amide wax and teflon powders, surface active agents based on fluorine and phosphoric ester, and silicone. Particularly preferred release agents are modified silicones inclusive of (1) a side chain type modified-silicone oil, (2) a both-terminated modified-  
10 silicone oil, (3) a one-terminated type modified silicone oil, (4) a both side-terminated type modified silicone oil, (5) methylpolysiloxane containing trimethylsiloxysilicic acid (called silicone resin), (6) silicone graft acrylic resin, and (7) methylphenyl silicone oil.

15 [0042]

The modified silicone oils are generally broken down into reactive silicone oils and non-reactive silicone oils. The reactive silicone oils, for instance, include those modified by such groups as amino, epoxy, carboxyl, carbinol,  
20 methacryl, mercapto, reactive (at one end), and foreign functional groups, and the non-reactive silicone oils, for instance, include those modified by polyether, methylstyryl, alkyl, higher fatty acid ester, hydrophilic group, higher alkoxy, higher fatty acid, and fluorine.

25 [0043]

Of the aforesaid silicone oils, particular preference is given to that of the type having a group capable to reacting with the film-forming component in the hologram-forming layer. This is because such silicone oil reacts with the  
30 film-forming component as the hologram-forming layer cures, so that it is bonded thereto. For this reason, this silicone oil is unlikely to bleed out on the surface of the hologram layer with the relief pattern formed thereon, so that unique performance can be imparted to the hologram layer. In  
35 particular, this silicone oil is effective for improvements in the adhesion of the hologram layer to a deposited layer at an evaporation step. Such a surface relief hologram layer as

mentioned above has a thickness of usually 0.1 to 50  $\mu\text{m}$ , and preferably 1 to 20  $\mu\text{m}$ .

For such a surface relief hologram, a reflective layer should preferably be formed between the hologram layer 2 and the heat seal layer 3. When a light reflective metal thin film is used for the reflective layer, an opaque hologram is obtained, and when a transparent substance different in the index of refraction from the hologram layer is used, a transparent hologram is obtained. In the present invention, both the reflective layers may be used. The reflective layer may be formed by known processes inclusive of sublimation, vacuum evaporation, sputtering, reactive sputtering, ion plating, and electroplating.

[0044]

For the light reflective layer for forming an opaque type hologram, for instance, use may be made of thin films of metals such as Cr, Ti, Fe, Co, Ni, Cu, Ag, Au, Ge, Al, Mg, Sb, Pb, Pd, Cd, Bi, Sn, Se, In, Ga and Rb and their oxides and nitrides, which may be used alone or in combination of two or more. Of these, metal thin films of Al, Cr, Ni, Ag and Au are especially preferred with a thickness of 1 to 10,000 nm, and preferably 20 to 200 nm.

[0045]

The thin film to form the transparent type hologram may be made of any desired material provided that it is of light transparency enough to produce a hologram effect. For instance, the thin film may be formed using a transparent material having a refractive index different from that of the resin for the hologram-forming layer. Although the refractive index of this transparent material may be higher or lower than that of the resin for the hologram-forming layer, it is understood that the refractive index difference is preferably at least 0.1, more preferably at least 0.5, and more preferably at least 1.0. Besides, metallic reflective films of up to 20 nm in thickness may be used. The transparent type reflective layer preferably used herein includes a titanium oxide ( $\text{TiO}_2$ ) film, a zinc sulfide ( $\text{ZnS}$ ) film, and a Cu-Al composite metal oxide film.

[0046]

Having the function of bonding the hologram layer 2 to an application member in a heat-sensitive fashion, the heat seal layer 3 is provided on one surface of the hologram layer 2 obtained as mentioned above (via the reflective layer where the hologram layer is of the surface relief type). The heat seal layer 3 comprises a heat-sensitive adhesive based on barriers such as ethylene-vinyl acetate copolymer resins, polyamide resins, polyester resins, polyethylene resins, ethylene-isobutyl acrylate copolymer resins, butyral resins, polyvinyl acetate resins and their copolymer resins, cellulose derivatives, polymethyl methacrylate resins, polyvinyl ether resins, polyurethane resins, polycarbonate resins, polypropylene resins, epoxy resins, phenol resins, thermoplastic elastomers such as SBS, SIS, SEBS and SEPS, and reactive hot melt resins. In consideration of adhesion to the application member, an appropriate selection may be made from these resins. Exemplary application members are a polyvinyl chloride sheet, a polystyrene sheet, a PET sheet and a high-quality paper sheet. In view of adhesion to these sheets, for instance, preference is given to EVA resin such as V200 made by Mitsui Chemicals, Inc., ethylene-vinyl acetate copolymer resin such as AD1790-15 made by Toyo Morton Co., Ltd. and M-720AH made by DIC, polyester resin such as A-928 made by DIC, acrylic resin such as A-450 made by DIC, and vinyl chloride-acetate resin such as A-100Z-4 made by DIC.

[0047]

To provide the heat seal layer 3 on the hologram layer 2, the heat-sensitive resin is dissolved or dispersed in a solvent such as toluene or methyl ethyl ketone to prepare a coating solution. Then, the coating solution is coated on a temporary carrier such as one represented by substrate 6 to a post-drying thickness of 2 to 20  $\mu\text{m}$  by means of a comma coater, a die coater or a gravure coater to prepare a releasable heat seal-forming layer. Finally, this heat seal-forming layer is transferred by lamination on the hologram layer 2 with the hologram recorded therein.

[0048]

The barrier layer 4 is provided for the purposes of bonding the surface protective layer 5 to the hologram layer 2 in a heat-sensitive fashion and preventing the migration of low-molecular-weight components such as organic solvents and surfactants from the surface protective layer to the hologram layer and the migration of low-molecular-weight components such as monomers and organic solvent from the hologram layer to the surface protective layer. It is preferable to form this barrier layer using water-soluble, heat-sensitive adhesives, for instance, water-soluble thermoplastic elastomers such as ethylene-vinyl copolymer resin, polyamide resin, polyester resin, polyethylene resin, ethylene-isobutyl acrylate resin, butyral resin, polyvinyl acetate resin and its copolymer resin, cellulose derivative, polymethyl methacrylate resin, polyvinyl ether resin, polyurethane resin, polycarbonate resin, polypropylene resin, epoxy resin and phenol resin. To this end, EC1200 and MC3800 made by Chuo Rika Kogyo Co., Ltd., AP-60LM made by Dainippon Ink & Chemicals, Inc., and V-100 and V-200 made by Mitsui Chemical Industries, Ltd. may be used.

[0049]

To transfer the barrier layer 4 on the side of the hologram layer 2 facing away from the heat seal layer 3 by means of dry lamination, the heat-sensitive adhesive, preferably the aqueous heat-sensitive adhesive is dissolved or dispersed in water or a solvent to prepare a coating solution. Then, the coating solution is coated on a temporary carrier such as one represented by substrate 6 by means of a comma coater, a die coater, a gravure coater or the like to form a barrier layer having a post-drying thickness of 0.5  $\mu\text{m}$  to 10  $\mu\text{m}$ .

[0050]

The surface protective layer 5 must have adhesion to the barrier layer 4 and releasability from the substrate 6. After the substrate 6 is released off, the surface protective layer 5 cooperates with the barrier layer to serve as a protective layer for the hologram layer 2. Comprising a methacrylic resin such as polymethyl methacrylate as a main

binder, the surface protective layer is required to have functions such as hard coatability, printability and slip capability because it must serve as a protective layer for the volume hologram layer 2. To achieve such functions, various additives are incorporated in the surface protective layer. For the binder, polyacrylate resins, polyvinyl chloride resins, cellulose resins, silicone resins, chlorinated rubber, casein, etc. may also be used. For the additives, use may be made of surface active agents, waxes and metal compounds which may be used alone or in admixture. [0051]

The surface protective layer 5 should preferably be formed using a material selected in such a way as to provide a peel force of 1 to 100 gf/inch (90° peeling), and preferably 1 to 5 gf/inch with respect to the substrate. The peel force between the surface protective layer 5 and the substrate 6 should be set such that when the hologram transfer foil of the present invention is applied on the heat seal layer side over an application member, it becomes smaller than that between adjacent layers in the multilayer structure, viz., between the surface protective layer and the barrier layer, between the barrier layer and the hologram layer, between the hologram layer and the heat seal layer, and between the heat seal layer and the application member. To form the surface protective layer, the starting composition is dissolved in an organic solvent to prepare an ink. Then, this ink is coated on the substrate 6 by known means such as coating. In consideration of releasability, tear capability and surface protection, the surface protective layer should preferably have a thickness of 0.1  $\mu\text{m}$  to 3  $\mu\text{m}$ . [0052]

For the releasable sheet 7 provided on the heat seal layer 3, use may be made of ordinarily used release paper as well as releasable films obtained by treating films such as polyethylene terephthalate or polypropylene films with releasing agents based on fluorine, silicone or the like. It is noted that even when no releasable sheet 7 is provided, a

sheet form of hologram transfer foil 1 may be superposed on itself or a continuous form of label may be rolled up. In this case, too, the heat seal layer has no adhesion to the upper surface of another label superposed thereon.

- 5 Nonetheless, it is preferable to laminate the releasable sheet 7 on the heat seal layer because the surface of the heat seal layer can be surely protected during storage of hologram transfer foil 1.

[0053]

- 10 To the hologram transfer foil of the present invention, a first multilayer film (1) comprising a PET film/hologram layer 2 with a relief or volume hologram recorded therein/film with the surface subjected to releasing treatment, a second multilayer film (2) comprising a surface  
15 protective layer 5/substrate 6, a third multilayer film (3) comprising a barrier layer 4/film with the surface subjected to releasing treatment and a fourth multilayer film (4) comprising a heat seal layer 3/releasable sheet 7 are first separately prepared.

- 20 [0054]

- Then, the third multilayer film is dry laminated on its barrier layer side over the surface protective layer of the second multilayer film at 50°C to 200°C, thereby preparing a fifth multilayer film comprising a barrier layer 4/surface  
25 protective layer 5/substrate 6.

[0055]

- Then, the film with the surface subjected to releasing treatment is released from the first multilayer film. Subsequently, the fifth multilayer film is dry laminated at  
30 50°C to 200°C on its barrier layer surface over the surface of the hologram layer with the hologram recorded therein, thereby preparing a sixth multilayer film comprising a PET film/hologram layer 2/barrier layer 4/surface protective layer 5/substrate 6.

- 35 [0056]

Then, the PET film is removed from the sixth multilayer film. Finally, the fourth multilayer film is dry laminated at 50°C to 200°C over the surface of the hologram layer (the

surface of the reflective layer laminated on the hologram layer when the hologram layer is a relief hologram layer).

[0057]

In this way, the hologram transfer foil of the present invention comprising a releasable sheet 7/heat seal layer 3/hologram layer 2/barrier layer 4/surface protective layer 5/substrate 6 can be obtained. This hologram transfer foil can be easily fabricated without having any adverse influence on the hologram, because both the barrier layer and the heat seal layer are formed by transfer.

[0058]

To transfer the hologram onto the application member using the hologram transfer foil of the present invention, the releasable sheet 7 is first removed from the hologram transfer foil. Then, the hologram transfer foil is heat laminated on the surface of the heat seal layer 3 over the application member at 50°C to 200°C, and preferably 80°C to 170°C, followed by removal of the sheet or carrier tape form of the substrate 6. In this way, a structure comprising the heat seal layer 3/hologram layer 2/barrier layer 4/surface protective layer 5 can be formed on the surface of the application member.

[0059]

If, in the hologram transfer foil of the present invention, the transfer layer comprising the heat seal layer 3/hologram layer 2/barrier layer 4/surface protective layer 5 is made transparent, it is then possible to directly see the surface of the application member that is the lower layer. For the application member, for instance, use may be made of paper, synthetic paper, plastic and metal films or sheets, glass or other transparent sheets, and opaque sheets. For plastics, use may be made of vinyl chloride resins, acrylic resins, polystyrene resins, polyester resins such as polyethylene terephthalate, and polycarbonate resins.

In what follows, the present invention is explained with reference to examples.

[0060]

#### EXAMPLES

(Example 1)

(First multilayer film comprising PET film/volume hologram-forming layer/PET film with the surface subjected to releasing treatment)

- 5        A coating solution having the following composition:  
         Photocurable resin composition for volume hologram layer  
         formation (containing as a basic binder a polymethyl  
         methacrylate resin (T<sub>g</sub>: 100°C) 60 parts by weight  
         Methyl ethyl ketone                                25 parts by weight  
10        Toluene    15 parts by weight

         was gravure coated to a post-drying thickness of 10 μm on a  
         PET film (of 50 μm in thickness, Lumirror T60, Toray  
         Industries, Inc.), and a PET film with the surface subjected  
         to releasing treatment (of 50 μm in thickness, SP-PET,  
15        Tohcello Co., Ltd.) was laminated on the thus obtained  
         coating surface.

[0061]

         Using laser light of 514 nm wavelength, a Lippmann  
         hologram was recorded in the volume hologram layer in the  
20        first multilayer film. Then, to fix the Lippmann hologram,  
         the first multilayer film was heated at 80°C for 5 minutes,  
         and then using a high-pressure mercury lamp (1,000 mJ/cm<sup>2</sup>).

[0062]

         (Second multilayer film comprising surface protective layer  
25        5/substrate 6)

         Hakuri Nisu UVC-5W (made by Showa Ink Industries, Inc.)  
         was coated to a post-drying thickness of 1 μm on a substrate  
         (of 50 μm in thickness, Lumirror T60 made by Toray  
         Industries, Inc.), using a gravure coater, thereby forming a  
30        surface protective layer on the substrate.

[0063]

         (Third multilayer film comprising barrier layer 4/film with  
         the surface subjected to releasing treatment)

         An aqueous heat-sensitive adhesive (EC1700 made by Chuo  
35        Rika Kogyo Co., Ltd.) was coated to a post-drying thickness  
         of 2 μm on a PET film with the surface subjected to releasing  
         treatment (of 50 μm in thickness, SP-PET made by Tohcello  
         Co., Ltd.), using a gravure coater.

[0064]

(Fourth multilayer film comprising heat seal layer 3/releasable sheet 7)

5 An aqueous heat-sensitive adhesive (V200 made by Mitsui Chemical Industries, Ltd.) was coated to a post-drying thickness of 2  $\mu\text{m}$  on a PET film with the surface subjected to releasing treatment (of 50  $\mu\text{m}$  in thickness, SP-PET made by Tohcello Co., Ltd.), using a gravure coater, to form a heat seal layer on the releasable sheet.

10 [0065]

(Fifth multilayer film comprising barrier layer 4/surface protective layer 5/substrate 6)

15 The third multilayer film was dry laminated at 90°C on its barrier layer side over the surface protective layer of the second multilayer film, and the film with the surface subjected to releasing treatment was removed from the third multilayer film, thereby preparing the fifth multilayer film.

[0066]

(Preparation of hologram transfer foil)

20 The PET film with the surface subjected to releasing treatment was removed from the first multilayer film with the hologram recorded therein. Then, the fifth multilayer film was laminated at 100°C on its barrier layer side over the surface of the hologram layer in the first multilayer film, 25 thereby obtaining a sixth multilayer film comprising a PET film/volume hologram layer 2/barrier layer 4/surface protective layer 5/substrate 6.

[0067]

30 Subsequently, the PET film contiguous to the volume hologram layer was removed, and the fourth multilayer film was laminated at 90°C on its heat seal layer side over the surface of the volume hologram layer. In this way, the hologram transfer foil of the present invention comprising a releasable sheet 7/heat seal layer 3/volume hologram layer 35 2/barrier layer 4/surface protective layer 5/substrate 6 was fabricated.

[0068]

The thus obtained hologram transfer foil was found to have a diffraction efficiency of 85.2% and a peak wavelength of 513 nm. After this hologram transfer foil was let standing at room temperature for 7 days, its optical properties were again evaluated. The diffraction efficiency and peak wavelength were 84.4% and 513 nm, respectively; they remained substantially unchanged. Aesthetic deterioration of the hologram layer such as discoloration was not visually observed.

10 (Heat transfer using the hologram transfer foil)

The releasable sheet 7 was removed from the thus fabricated hologram transfer foil of the present invention, and this hologram transfer foil was laminated on its heat seal layer 3 side over a transparent acrylic film at 130°C and 0.7 MPa for 1.5 sec. After the laminate was fully cooled, the substrate 6 was removed therefrom, thereby obtaining a volume hologram laminate comprising the transparent acrylic film and, in order therefrom, a heat seal layer 3/volume hologram layer 2/barrier layer 4/surface protective layer 5.

20 [0069]

After let standing at room temperature for 7 days, this volume hologram laminate was again evaluated for its optical properties. The diffraction efficiency and peak wavelength were 83.9% and 513 nm, and a definite hologram image could be observed with neither brightness drops nor recorded wavelength shifts.

[0070]

(Comparative Example 1)

30 The first multilayer film with the volume hologram recorded therein, the second multilayer film and the fourth multilayer film were provided as in Example 1.

[0071]

(Preparation of hologram transfer foil)

35 The PET film with the surface subjected to releasing treatment was removed from the first multilayer film with the hologram recorded therein. Then, the second multilayer film was laminated at 100°C on its surface protective layer side

over the surface of the hologram layer in the first multilayer film, thereby obtaining a multilayer film comprising a PET film/volume hologram layer/surface protective layer/substrate.

5 [0072]

Subsequently, the PET film contiguous to the volume hologram layer was removed, and the fourth multilayer film was laminated at 90°C on its heat seal layer side over the surface of the volume hologram layer. In this way, a comparative hologram transfer foil comprising a releasable sheet/heat seal layer/volume hologram layer/surface protective layer/substrate was fabricated.

[0073]

This hologram transfer foil was laminated on a transparent acrylic film as in Example 1. After let standing at room temperature for 7 days, the laminate was evaluated for its optical properties. While the diffraction efficiency was 83.9%, the peak wavelength was largely shifted to 497 nm.

[0074]

20 (Comparative Example 2)

Instead of the third multilayer film comprising the barrier layer 4/film with a releasing surface, the third multilayer film was prepared as in Example 1 with the exception that an aqueous heat-sensitive adhesive (V200 made by Mitsui Chemical Industries, Ltd.) was coated on a PET film (of 50  $\mu\text{m}$  in thickness, SP-PET made by Tohcello Co., Ltd.) to a post-drying thickness of 2  $\mu\text{m}$  by means of a gravure coater. Under otherwise the same conditions, a hologram transfer foil was prepared.

30 [0075]

This hologram transfer foil was laminated on a transparent acrylic film as in Example 1. After let standing at room temperature for 7 days, the laminate was evaluated for its optical properties. While the diffraction efficiency was 84.1%, the peak wavelength was slightly shifted to 507 nm.

[0076]

(Example 2)

Instead of the first multilayer film comprising the PET film/volume hologram-forming layer/PET film with the surface subjected to releasing treatment, another first multilayer film comprising a PET film/relief hologram layer/reflective layer/PET film with the surface subjected to releasing treatment was fabricated as follows.

[0077]

(Exemplary preparation of ionizing radiation-curing type urethane-modified acrylic resin that is a relief hologram-forming material)

A 2-liter four-necked flask equipped with a cooler, a dropping funnel and a thermometer was charged with 40 grams of toluene and 40 grams of methyl ethyl ketone (MEK) together with an azo initiator. Then, a mixed solution of 22.4 grams of 2-hydroxyethyl methacrylate (HEMA), 70.0 grams of methyl methacrylate (MMA), 20 grams of toluene and 20 grams of MEK was added dropwise to the charged materials through the dropping funnel over about 2 hours for an 8-hour reaction at a temperature of 100 to 110°C, after which the reaction product was cooled down to room temperature.

[0078]

A mixed solution of 27.8 grams of 2-isocyanate ethyl methacrylate (Currens MOI made by Showa Denko K.K.), 20 grams of toluene and 20 grams of methyl ethyl ketone was added to the reaction product for an addition reaction using dibutyltin laurate as a catalyst. Upon confirmation by IR analysis of the disappearance of an absorption peak of 2,200  $\text{cm}^{-1}$  for the isocyanate group in the reaction product, the reaction was completed.

[0079]

The obtained resin solution was found to have a solid content of 41.0% and a viscosity of 130 mPa·sec. (at 30°C). As measured by GPC on a standard polystyrene basis, the resin solution had a molecular weight of 35,000 and the average amount of C=C bonds introduced per molecule was 13.8 mol%.

[0080]

(Preparation of photo-curable resin composition)

Resin solution produced as mentioned above (on a solid basis)  
100 parts by weight

Releasing agent (trimethylsiloxysilicic acid-containing  
methylpolysiloxane KF-7312 made by the Shin-Etsu Chemical

5 Co., Ltd.) 1 part by weight

Polyfunctional monomer (SR-399 made by Sirtomer Co., Ltd.)

10 parts by weight

Polyester acrylate (M-6100 made by Toa Synthesis Co., Ltd.)

10 parts by weight

10 Photosensitizer (Irgacure 907 made by Chiba Specialty  
Chemicals Co., Ltd.)

5 parts by weight

Each of the aforesaid components was diluted with methyl  
ethyl ketone to obtain a composition having a solid content  
regulated to 20%.

15 [0081]

(Preparation of reflection type surface relief hologram)

A release layer (Hakuri Nisu 45-3 made by Show Ink  
Industries, Inc.) was coated on a polyethylene terephthalate  
film (PET of 25  $\mu$ m in thickness, Lumirror T60 made by Toray  
20 Industries, Inc.) at a rate of 50 m/min. by means of gravure  
coating, followed by drying at 100°C to volatilize off the  
solvent. In this way, a film comprising a release layer  
having a post-drying thickness of 1 to 2 g/m<sup>2</sup> and a PET layer  
was obtained.

25 [0082]

The photo-curable resin composition obtained as  
mentioned above was coated on the release layer of the film  
comprising the release layer/PET layer by means of a roll  
coater, followed by drying at 100°C to volatilize off the  
30 solvent. In this way, a photosensitive film for replication  
was obtained with a post-drying thickness of 2 g/m<sup>2</sup>. The  
obtained film remained ungummed and so could be stored in a  
rolled form.

[0083]

35 A press stamper prepared from a master hologram made  
using laser light was set on an emboss roller in a replicaton  
system, and the thus obtained photosensitive film for  
replication was positioned on the feed side of the the

system, so that the photosensitive film was thermo-pressed at 170°C to form a fine relief pattern thereon. Instead of this master hologram, it is acceptable to replicate a hologram from a master hologram using a resin plate and apply the  
5 replicated hologram on a cylinder.  
[0084]

Then, the photosensitive film was photo-cured by irradiation with ultraviolet rays from a mercury lamp, and an aluminum layer was subsequently deposited by vacuum  
10 evaporation on a fine relief pattern to a thickness of 500 Å, thereby forming a reflection type relief hologram. Finally, a PET film with the surface subjected to releasing treatment was applied over the surface of the relief hologram, thereby fabricating a multilayer film comprising a PET/release  
15 layer/surface relief hologram layer/reflective layer/PET film with the surface subjected to releasing treatment.  
[0085]

(Preparation of the hologram transfer foil)

The PET film contiguous to the release layer was removed  
20 from the multilayer film with the hologram recorded therein. Then, the fifth multilayer film obtained in Example 1 was laminated at 100°C on its barrier layer side over the surface of the hologram layer of the multilayer film, thereby obtaining a multilayer film comprising a PET film with the  
25 surface subjected to releasing treatment/reflective layer/surface relief hologram layer 2/barrier layer 4/surface protective layer 5/substrate 6.  
[0086]

Then, the PET film with the surface subjected to  
30 releasing treatment was removed from the multilayer film, and the fourth multilayer film obtained in Example 1 and comprising the heat seal layer/releasable sheet was laminated at 100°C on its heat seal layer side over the surface of the reflective layer of the multilayer film. In this way, the  
35 hologram transfer foil of the present invention comprising a releasable sheet 7/heat seal layer 3/reflective layer/hologram layer 2/barrier layer 4/surface protective layer 5/substrate 6 was obtained.

[0087]

The obtained hologram transfer layer, from which the releasable sheet was removed, was heat transferred onto a vinyl chloride substrate at 160°C and 0.7 MPa for 0.5  
5 seconds. The peel strength between the surface protective layer and the substrate was 70 gf/inch, indicating that the substrate was of satisfactory releasability.

[0087]

(Comparative Example 3)

10 Example 2 was repeated with the exception that the second multilayer film obtained in Example 1 and comprising the surface protective layer/substrate was used in place of the fifth multilayer film, thereby preparing a multilayer comprising a PET film with the surface subjected to releasing  
15 treatment/reflective layer/surface relief hologram layer/surface protective layer/substrate.

[0089]

Then, the PET film with the surface subjected to releasing treatment was removed from the multilayer film, and  
20 the fourth multilayer film obtained in Example 1 and comprising the heat seal layer/releasable sheet was laminated at 100°C on its heat seal layer side over the surface of the reflective layer of the multilayer film. In this way, a hologram transfer foil comprising a releasable sheet /heat  
25 seal layer/reflective layer/surface relief hologram layer/surface protective layer /substrate was obtained.

[0090]

The obtained hologram transfer layer, from which the releasable sheet was removed, was heat transferred onto a  
30 vinyl chloride substrate at 160°C and 0.7 MPa for 0.5 seconds. The peel strength of the substrate with respect to the surface protective layer was as large as 130 gf/inch or had increased adhesion force. As a result, the cohesive breakdown of the surface protective layer occurred upon a  
35 release of the substrate from the surface protective layer, probably because the migration of the low-molecular-weight component from the surface relief hologram layer into the

surface protective layer might impede the smooth release of the substrate from the surface protective layer  
[0091]

#### EFFECT OF THE INVENTION

5       According to the present invention, there can be provided a hologram transfer foil which enables a hologram image, etc. to be reconstructed in an uninterrupted manner, and is improved in terms of releasability with respect to a substrate, especially when the hologram is of the surface  
10 relief type.

#### BRIEF EXPLANATION OF THE DRAWING

Fig. 1 is illustrative in section of one embodiment of the transparent hologram transfer foil according to the present invention.

#### 15       EXPLANATION OF THE REFERENCE NUMERALS

Reference numeral 1 is a hologram transfer foil, 2 a hologram layer, 3 a heat seal layer, 4 a barrier layer, 5 a surface protective layer, 6 a substrate, and 7 a releasable sheet.

NAME OF THE DOCUMENT  
ABSTRACT OF THE DISCLOSURE

ABSTRACT

OBJECT

5       The invention has for its object to provide a hologram transfer foil which enables a hologram image, etc. to be reconstructed in an uninterrupted manner, and is improved in terms of releasability with respect to a substrate, especially when the hologram is of the surface relief type.

10                   RESOLVING MEANS

          A hologram transfer foil comprises a substrate and a transfer layer laminated thereon, said transfer layer comprising a surface protective layer, a barrier layer, a hologram layer and a heat seal layer in this order. At the  
15 time when the hologram transfer foil is applied on the heat seal layer side to an application member, the peel force between the substrate and the surface protective layer is smaller than that between adjacent layers in other layers.

                  REFERRED-TO DRAWING

20                               FIG. 1

【書類名】 図面  
(DOCUMENT NAME)

Drawing

【図1】 (FIG. 1)

